

Photo courtesy of Yiftach Kleinman, Business Development Manager, Rafael



Israeli Merkava Mk 4 Main Battle Tanks with Trophy in operation. The Israeli Defence Forces has now equipped a full Merkava Mk 4 brigade with Trophy.

ACTIVE PROTECTION SYSTEMS: A POTENTIAL JACKPOT TO FUTURE ARMY OPERATIONS

by Michael MacNeill

Introduction

Whether one looks at conventional state actors such as North Korea and Iran, or nationalist and ethno-religious asymmetric threats, such as those found in the Sudan, Afghanistan and Somalia, many within the wider academic community have identified a measurable growth of instability within the international system since the end of the Cold War in the early-1990s. This growth in geopolitical instability, along with economic and domestic political factors, has resulted in a recent transition of Canadian foreign policy. Canada has witnessed a measurable shift from largely lower-level conflict and United Nations-based peacekeeping operations, such as the Suez, Cyprus, Iraq, and even Bosnia, to now include more volatile operations in Kosovo, Afghanistan and Libya. But while the Canadian government has decided to slowly wind down operations in Afghanistan by temporarily shifting our remaining forces from a ‘combat role’ to a presumably less dangerous training facilitation role with the Afghan National Army around the Kabul region, our activity in this turbulent region has nevertheless hammered home the need for greater protection for our armoured combat vehicle fleet in future expeditionary operations. Extensive resources have been provided

to improve communications, counter-improvised explosive device technologies and techniques, and countless other efforts limit the potential casualties incurred through both enemy contact and fratricide. Considerable effort has also been dedicated to improving the traditional armour protection of our individual personal protective equipment with newer protective vests, and there has been an evolution of add-on armour packages for our older and up-and-coming combat vehicles. It is the position of this article that while traditional avenues of increasing armour protection to our fleets of combat vehicles have merit, such considerations should also embrace non-traditional protective measures. Any future Canadian expeditionary force should also include the introduction of Active Protection Systems.

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LAV IIIs and a *Leopard* tank forming up for Operation Rear Entrance in the Panjwa'i district of Afghanistan, 8 June 2007.

evident, but usually at the expense of an individual's mobility and flexibility.¹ This correlation of armour weight with limited mobility with regard to individual speed, endurance, and flexibility of movement represents what will henceforth be referred to as the armour conundrum.

This same armour conundrum also finds expression with the advent of mounted armour. Both the heavily armoured mounted knights of the late-Middle Ages and the *King Tiger* tank of the German *Wehrmacht* during the Second World War provided considerable protection against much of an enemy's arsenal, but both were very slow and cumbersome on the battlefield. Along with the weight factor,

The Armour Conundrum

Since the introduction of standardized armoured soldiers with Greek Phalanxes and Roman Legions, Western society has been fascinated with providing the greatest potential protection of its military forces to help facilitate victory. Historically, this focus upon introducing body armour was a given regime's effort to reinforce the myth of survivability in order to boost their troops' confidence and courage, even when subjected to the carnage of close combat. Even today, the use of the term 'body armour' serves somewhat as a misnomer. While such systems may lend some increased potential protection for a soldier, it is by no means a guarantee. Regardless of the ultimate value of armour protection, Western military history has provided us with evidence of the continual ebb and flow of this line of thought through the evolution of the armoured knight of the medieval period, to the full introduction of standardized helmets and tanks during the First World War, and even the re-introduction of body armour variants for the average soldier by the 1960s. The inclusion of armour protection does, however, have one key physical limitation, that of weight.

Throughout history, there have always been difficult problems which had to be addressed when introducing armour protection to either personnel or equipment. Whether as an individual Roman legionary carrying his heavy chain mail shirts, or *lorica segmentata*, to armoured foot knights of the Middle Ages, the advantages armour provided to protection were

the armour conundrum also includes the constant ebb and flow of the technology gap. Whereas a formation of heavy mounted knights could readily break a wall of well-disciplined infantry, the large-scale introduction of organized archers, such as occurred at the Battle of Agincourt, eventually led to the end of the knight's supremacy on the medieval battlefield. Simply put, for each advancement in armour protection, there is an eventual leap in anti-armour weaponry, and vice-versa. Throughout much of our history, this has revolved around adding additional heavier layers of iron or steel, which directly influenced armour conundrum's weight factor yet again.



The Battle of Agincourt (1415). From the *Chronicles of Saint Albans*, Flemish, 15th Century. Note the archers.



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A Mark IV tank getting ready to move out during the Amiens Offensive, 8 August 1918.

The armour conundrum has witnessed dramatic technological advancements since the end of the Second World War. By the end of that conflict, advances were made in anti-armour weaponry with the development of new weapons projectiles, such as the sabot round. The sabot, which is largely composed of the exceptionally strong metal known as tungsten, had the ability to punch holes through all existing armour at the time. In consequence, advances were also made in composite and modular armour plating for armoured vehicles, which ultimately found expression in many of the present-day battlefield giants such as the *Challenger*, *Abrams*, *Leclerc* and *Leopard* Main Battle Tanks (MBTs) of the west, as well as highly functional Infantry Fighting Vehicles (IFVs), such as the *Bradley* and the *Warrior*.

“Even today, the use of the term ‘body armour’ serves somewhat as a misnomer.”

(hp/t). The newest version, labelled the *Leopard 2A7+*, weighs almost 68 tonnes “... when optimized for urban operations,” and thus results in a decreased power-to-weight ratio now at 22.22 hp/t.² This serves as one of many examples of how increasing the weight of combat vehicles by only including additional traditional armour will only continue to have an “... adverse effect on vehicle mobility and can also mean that the power-pack (including the engine, transmission and cooling system) and suspension have to be upgraded to maintain cross-country mobility.”³ The sole utilization of traditional armour protection schemes is no longer sufficient. Rather, a collaborative effort must be considered with both traditional armour technology and other avenues, such as Active Protection Systems (APS). Only by a combination of passive and pro-active armour protection can modern armies compensate for the armour conundrum, and thus make their combat vehicle fleets more mobile and deployable.



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A Canadian 8th Hussars *Firefly* tank passes through Putten in Holland on the way to the Zuider Zee, 18 April 1945. Note the different varieties of steel track welded to the front of the hull for additional protection.

The Development and Availability of APS Today

Initial industrial research into the potential of APS, sometimes referred to as Defensive Aids Systems, began in the late-1990s, and has resulted in the availability of many of these products within today’s commercial market and foreign armed forces.⁴ Such systems have found considerable value, due to the recognition of the inherent weakness and limitations of traditional armour protection systems within the modern complex battlespace. Whereas traditional armour systems, including explosive-reactive, composite, spaced and layered modular armour, or a combination thereof, are based upon the

incoming projectile being defeated by the strength and slope of the vehicle's metallic material, or detonated prior to striking the plate and thus significantly limiting its potential penetrating effects, an APS package takes this concept one step further. It focuses more upon eliminating incoming munitions before they reach the vehicle. The system represents an integrated package that revolves around a 6400 mils radar-based detection system directly linked to either a 'hard-and soft-kill' strike kit, or a combination of the two. Should the system either expend its protective munitions, or a projectile penetrate the APS 'bubble,' the traditional armour package would serve as the last line of defence for both the vehicle and its crew. This new approach theoretically tosses the traditional idea of armour protection on its head. It is now the role of traditional armour packages to complement initial bubble of protection provided by APS packages.

This ability to protect MBT and IFV fleets by detecting the approach of incoming projectiles and missiles, immediately swinging the strike kit and eliminating the threat by either intercepting or jamming its approach, represent "... a higher level of protection against Rocket Propelled Grenades (RPGs) and Anti-Tank Guided Weapons (ATGWs), as well as some lower-velocity gun-launched projectiles fired from main battle tanks (MBTs)."⁵

The employment of APS kits to in-service armour combat vehicles is becoming an increasingly common practice. The Russians, Ukrainians, and Israelis have already begun to implement such systems, not only in their own armed forces, but also for export. The Russians have begun to fit the *Arena-E* hard-kill and *Shtora-1* soft-kill systems to the BMP-3



Armoured soldiers from 3rd Battalion, The Royal Canadian Regiment Battle Group, aboard a *Leopard 2*, rumble to their battle position in the Zharey district of Afghanistan during Operation *Janubi Tapu 2*, 25 November 2008.

DND photo AR2008-J011-181 by Corporal James Nightengale

series of IFVs. The *Shtora-1* APS has already been mated with some of their T-90 MBT fleet.⁶ The Ukraine's state-owned Ukrspec-export has stepped up export marketing of their *BM Oplot* MBT, based upon a heavily modified T-84 version. Purchase of this new MBT can include both the *Varta* electro-optical counter-measures soft-kill and *Zaslon* hard-kill APS kits. While it is yet unsure if Thailand's procurement of 100 *Oplot* MBTs will include the APS kits, it is quite possible that the Ukrainian Army's original 10 *Oplots* will be upgraded.⁷

The Israeli Defence Force (IDF) drew upon lessons learned from their 2006 Lebanon conflict, and have since made massive strides to implement APS kits on their *Merkava* Mk 4 MBTs and *Namer* heavy IFVs. In December 2010, the IDF "... deployed its first battalion of *Merkava* Mk 4 MBTs equipped with Rafael's *Trophy* APS...

[which] provides 360-degree protection against ATGWs, rocket propelled grenades and tank-fired high explosive anti-tank (HEAT) rounds."⁸ According to *Jane's Defence Weekly*, the system "consists of an *Elta* radar linked to four antennas located on the front, rear, and sides of the MBT...(which) detects threats and then activates one of two launchers that discharges a cloud of hard-kill countermeasures to initiate and neutralize the incoming warhead."⁹ Meanwhile, the *Namer* heavy IFV, based upon the chassis of a *Merkava* MBT, will include a combination of the Israel Military Industry's *Iron Fist* APS and Rafael's technology for the same purpose.



A *Leopard 2* tank firing to adjust its 120 mm gun in the Panjwa'i district of Afghanistan, 14 February 2008.

DND photo AR2008-Z110-04 by Corporal Simon Duchesne

Photo (DSC_8213) courtesy of Yiftach Kleinman, Business Development Manager, Rafael



Israeli *Merkava* Mk 4 MBTs equipped with the *Trophy* Active Protection System (APS).

Although the presence of APS packages has witnessed considerable growth over the last several years, other systems are also readily available on the market. Some of these include Textron Systems' Tactical Rocket-Propelled Grenade Airbag Protection System (TRAPS), ARTIS Corporation's AMAP-ADS, and Saab's Land Electronic Defence System (LEDS). Along with several other systems, each of these is presently being tested and considered for the United States military's 'Future Combat Systems' program.¹⁰ Like most of its other competitors, Saab's LEDS comes in various levels of active protection. The LEDS-50 package includes the "Active Defence Controller (ADC) and a number of laser warning sensors" for "... 360 degree azimuth coverage of a platform by using four LWS-310 sensors," including the possibility of a LWS-500 version for the detection of full-hemispherical covers such as top attack munitions.¹¹ The LEDS-100 provides soft-kill "multi-spectral smoke" countermeasures by means of the High Speed Directed Launcher (HSDL). According to Saab, this system is "effective against laser based targeting and guidance systems, such as range finders, designators and beamriders."¹² Meanwhile, the LEDS-150 version includes the *Mongoose* hard kill missile to "physically destroy the efficiency of the thermal ballistic capability without residual penetration of the protected vehicle."¹³ According to Saab, the system as a whole can simultaneously detect, track and eliminate multiple incoming projectiles through a tandem firing capability with the *Mongoose* interceptor missile.¹⁴ Saab claims that their system is effective against RPGs, anti-armour missiles, recoilless rifles, and anti-tank guns firing high-explosive (HE), HESH, and HEAT ammunition with low collateral damage.¹⁵

APS as a Future Jackpot for Canadian Expeditionary Operations

While the potential introduction of APS technology into the armour conundrum has some theoretical benefits, the real question revolves around what such a kit could provide to the Canadian Army in future operations. Much of this depends upon *if*, and *how*, the Government employs its military resources in the future. There has been some direction on this issue of future employment, with Ottawa publically outlining its desire for the maintenance of a small, yet highly effective and flexible army able to operate within multitude of potential conflict types, sometimes concurrently.

Over the last decade, many in the government and military establishments have aimed at developing a Canadian Forces able to operate, not only at home, but also on expeditionary operations under varying approaches, such as U.S. Marine General Charles Krulak's concept of the 'three block war' scenarios.¹⁶ While it is not the aim of this article to enter into the debate of the 'pros and cons' of such concepts, there is a general recognition among many in both the Government and military that we must be able to deploy to theatres of operation abroad that can quickly vary from low-level peace-keeping and humanitarian intervention conflicts, to higher-level asymmetric and conventional counter-insurgency and war fighting scenarios. As a result, it is the position of this article that the introduction of APS technology to the army's armoured combat vehicle fleet is advantageous where expeditionary operations may become more prevalent.



Saab LEDS 150 fitted to a BAE Systems CV 90 *Armadillo*.

Since the end of the Cold War in the early-1990s, countless sub-national entities have surfaced. This has occasionally led to the establishment of new countries, such as the now-separate Czech and Slovak Republics, and the somewhat

BAE Systems and Saab

peaceful introduction of the Ukraine, Georgia, and the Baltic states of Lithuania, Latvia, and Estonia onto the international stage. Unfortunately, these largely peaceful developments only represent a small percentage of what has become a violent and turbulent late 20th Century and early 21st Century. Much of this period has been characterized by global economic difficulties, the persistence of aggressive regimes such as North Korea and Iran, the tenacity of international terrorism, and the cancer of countless failed states within the international community. As the most significant internationally legitimate and legally binding inter-governmental organization, the United Nations *has* and *continues to make* a concerted effort to resolve these difficulties through peaceful diplomatic and cooperative means, albeit occasionally without success. When these failures have occurred, for whatever reason, the United Nations has had to call upon its member states, and more often, alliance bodies, such as the North Atlantic Treaty Organization (NATO) and the African Union, to help enforce its resolutions. But this was not the original intent of NATO. NATO was originally developed to counter the potential threat of aggressive Soviet expansion while promoting economic and political cooperation among like-minded states. Unfortunately, both Canada and its NATO partners have come to witness more military action in the last 20 years than it had throughout the entire War Cold War era. Some of these actions have included the involvement of military forces in Bosnia, Kosovo, Afghanistan, and Libya, as well as predominantly naval operations off Somalia. Along with our involvement in NATO-led operations in far-off lands, Ottawa has also increasingly employed its military capabilities on countless humanitarian intervention missions, such as Haiti and the 2004 Tsunami in Japan. The Government has even gone so far as to publically affirm that this trend is not likely to end, especially with the West's additional focus on fighting the 'war on terrorism.' According to Prime Minister Stephen Harper:

Canadians live in a world characterized by volatility and unpredictability. Looking back, it is clear that the peace dividend that resulted from the end of the Cold War was relatively short-lived. The 1990s saw the emergence of difficult security challenges, including failed and failing states, civil wars and global terrorism. Many countries, including Canada, were slow to fully appreciate and adjust to these new realities. Today we live in an uncertain world, and the security challenges facing Canada are real. Globalization means that developments abroad can have a profound impact on the safety and interests of Canadians at home.¹⁷

“Canada’s geopolitical end-state is clear. It will not isolate itself from international humanitarian and security requirements abroad.”

With the advent of the *Canada First Defence Strategy*, the Government has outlined a firm direction on foreign and defence policy by reaffirming its commitment to keep Canada and its citizens safe and secure, thus “... ensuring that Canada can return to the international stage as a credible and influential country, ready to do its part.” It also outlined the Government’s plan for “... rebuilding the Canadian Forces into a first-class, modern military...(as) a fundamental requirement if we are to deliver on these goals...(while) recognizing that global security challenges and the capabilities required to meet them will continue to evolve...”¹⁸ Canada’s geopolitical end-state is clear. It will not isolate itself from international humanitarian and security requirements abroad. Rather, it will proactively participate within the international system to work with like-minded states and allies to legitimately project security requirements abroad in order to protect the nation’s interests. This has increasingly found expression through our increasing involvement in expeditionary operations since the 1990s, regardless of the level or type of conflict. To facilitate this, the Government has publicly directed that Canadian’s require a ‘state-of-the-art’ military with a flexible, multi-purpose capability that will enable the country to respond effectively and successfully to a sundry of potential military operations in the near future. This would naturally include an ongoing requirement for a highly mobile and versatile armoured combat vehicle fleet.



Trophy mounted upon and successfully integrated with a General Dynamics (Land) Stryker Infantry Fighting Vehicle (IFV). The Stryker is derived from the Canadian LAV III IFV.

While military procurements are usually a lengthy and detailed process involving many governmental departments and stake holders with varying agendas, the potential gains of an APS system for the army’s combat vehicle fleet easily outweigh the losses. The gains include an increasingly available and highly versatile defensive capability that could assist in alleviating the armour conundrum, to a possible improvement of the air mobility potential of our armour vehicle fleet, with the likely limited exception of Main Battle Tanks. The poten-

Photo (Trophy-on-Stryker 31) courtesy of Ylflach Kleinman, Business Development Manager, Rafael

tial reduction in weight requirements afforded by an APS system will significantly counteract the armour conundrum, and thus provide a direct advantage to the deployability of our combat armour vehicles by our air mobility resources, such as the C-17 and C-130 fleets. The employment of such a system on expeditionary operations would theoretically facilitate the speedy 'ride-on, ride-off' deployment of armoured vehicles, as compared to only utilizing the more traditional modular and add-on armour kits which, aside from adding to vehicle weight, also require considerable time, equipment, and resources to outfit vehicles upon arrival. For example, according to *Jane's*, the total combined weight of the Rafael's *Trophy* APS is only roughly 800 kilograms.¹⁹ While this may sound like a lot to the average light infantry company commander, it is very little compared to the average weight of add-on armour packages for IFVs and MBTs.



DND photo LX2013-002-050 by Master Corporal Dan Pop

The Department of National Defence receives the first modernized LAV III from General Dynamics Land Systems Canada in London, Ontario, 24 January 2013. The upgrades and enhancements will help protect soldiers against Improvised Explosive Devices (IEDs), land mines, grenades and other threats. This is part of an upgrade project for 550 LAV IIIs. The upgrade project is one of four Family of Land Combat Vehicles projects that aim to capitalize upon both existing and evolving technology to improve the protection, mobility, and lethality of the LAV III fleet.

With the publication of the *Canada First Defence Strategy*, the Government has publically dedicated itself to rebuilding the Canadian Forces into a first-class, modern military to include "... the progressive acquisition of a new family of land combat vehicles and systems that will prove robust and flexible for Canada's soldiers on high-risk missions abroad."²⁰ Much of this falls under a program called the Family of Land Combat Vehicles (FLCV) projects. The program is "... valued at approximately \$5 billion, including an estimated \$1 billion to upgrade the current fleet of Light Armoured Vehicles," and the delivery of the next generation of land combat vehicles.²¹ The Government has also made countless other heavy expenditure to improve the military's armour combat vehicle potential at home and abroad. The procurement of 100 *Leopard 2* MBTs represents an initial investment of \$650 million, \$95 million for 75 RG-31, and the still-undetermined cost of upgrading up to 630 LAV IIIs for roughly \$1.064 billion in the very near future.²² Then, there is the potential cost of the Government's planned procurement of other future programs, such as a new Close Combat Vehicle. This all represents a very significant investment in a future armoured combat vehicle fleet that needs to be capable of operating in a myriad of potential theatres of operations while engaged in both domestic and expeditionary activities. The inclusion of APS suites on the above mentioned fleets, and any future programs, would easily fall under what the Government has entitled providing a "state-of-the-art military that Canada needs and deserves" with a "flexible, multi-purpose capability that will enable the Canadian Forces to respond effectively and successfully to the full spectrum of (future) military operations."²³

Recent experiences by the Canadian and coalition armies in Afghanistan and Iraq have demonstrated the "... ongoing requirement for a highly protected, yet highly mobile light-armoured vehicle" to counter not only mines and improvised explosive devices, but also to defeat "anti-armour weapons (that have) become more prevalent, posing a greater risk to personnel."²⁴ At present, the proposed upgrades include the "installation of additional armour, heightening its protection against increased threats."²⁵ This will likely revolve around additional modular armour packages and cages to deal with incoming projectiles, such as those launched by RPGs and ATGWs. Unfortunately, these modernizations or upgrades continue to represent the two central criticisms brought forward in this article. In addition to falling back upon premise of allowing incoming projectiles and missiles to strike our vehicles and then 'hope for the best,' the increase of traditional armour packages inherently leads to significant growth in total vehicle weight. This consequently means a requirement for the "upgrade of mobility systems, such as powertrain, suspension, running gear, and brakes..."²⁶ As a result, these additional mobility upgrades could prove to be an unnecessary substantial expense. While upgrades are always going to be a factor, the real issue is whether the army should 'continue down the stove-pipe' of traditional protection, or look to a more composite layered approach where APS packages serve to eliminate incoming projectiles before they strike vehicle crews. Focus should be more upon eliminating incoming projectiles before they reach a vehicle. As a result, the role of traditional armour should be to complement the 'initial bubble' of protection provided by APS packages and to defeat small arms fire.



A convoy that includes a LAV III and a *Leopard 2A6M* Main Battle Tank during operations in the volatile Panjwa'i and Zhari districts of Kandahar Province, Afghanistan, 13 October 2010. The camel is not an official participant.

significantly outweigh the negatives. The financial costs, although not insignificant, are miniscule when compared to the increased potential loss of life on future expeditionary operations conducted upon a highly unstable international stage.

The material and human toll of the army's involvement in Bosnia, Kosovo, and Afghanistan has been significant, but hopefully, not in vain. Along with providing invaluable assistance to the Afghan populace, we have learned many new lessons with respect to asymmetric and expeditionary operations, and validated the need for increased interoperability with our NATO allies and other like-minded coalition partners. The significant expansion of networks for inter-agency and

Conclusion

In today's networked-based CNN-covered international conflicts, where violence and loss are commercially valuable marketing and sales tools, the difference between mission success and failure not only comes down to issues of defeating enemy forces and limiting collateral damage. Mission failure can also result from the potential loss of small numbers of friendly forces and resources due to enemy fire. Western populations are, at present, not willing to indulge in the large losses of friendly troops which were representative of the Second World War. Even the loss of a single platoon can have dramatic political ramifications which could ultimately result in the withdrawal from coalition operations, due to political pressure at home. This departure could result in a continued ripple effect to include the likely loss of credibility in the face of our partners and allies, which could potentially have additional political and economic consequences. While nothing can guarantee that such losses will never occur, outstanding leadership, training, and the application of pivotal equipment, such as APS suites, can have a very significant influence upon mission success. Regardless of which course of action one takes in looking at the possible introduction of APS suites on the army's combat vehicle fleet, the positives

inter-governmental cooperation, along with continued recognition of the need for cooperation with non-governmental organizations, has provided considerable insight and benefits when dealing with humanitarian intervention and low-level conflicts. But while the employment of the army strictly along conventional lines may have taken a temporary back seat to largely-asymmetric operations, it is widely recognized that we must not lose this skill-set. We do possess the unfortunate trait of always training for the last war when preparing for future operations. Rather, the army must be more flexible and functional in its approach. This has everything to do with ensuring the maintenance of top-grade training and equipment, such as our fleet of armoured combat vehicles.



Photo IMG-013-1 courtesy of ADS Protection, Deutschland

A RMMV *Fuchs 1 A8* IFV equipped with ADS HAT ~ A full rocket and missile Active Defence System.

Photo IMG-09-1 courtesy of ADS Protection, Deutschland

There is a high probability that the army's deployment to future conflicts will revolve along a combination of any number of levels of involvement. This could include both conventional and asymmetric operations, along with humanitarian intervention and peace-building activities, sometimes conducted in urgent relation to one another, when based upon either a spatial or time-linear proximity. But in order for the small Canadian army to properly provide a viable role in such activities, it must not only continue to develop its highly professional and capable human resources, but also take advantage of lessons learned by itself and other states when considering what equipment to stock in its 'operational tool box' in order to facilitate success. The inclusion of APS packages for the army's combat armour vehicle fleet, and the subsequent adaptation of tactics, techniques, and procedures for its application can only improve the potential survivability of our limited

personnel and material resources during future expeditionary operations. In the end, APS systems serve as another critical mission enabler.



A Patria AMV (8x8) equipped with ADS HAT ~ A full rocket and missile Active Defence System.

NOTES

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